

The Value of the Right Competence

A portrait of Fabrizio Sara, a middle-aged man with short grey hair, wearing a dark blue button-down shirt. He is smiling slightly and looking towards the camera. The background is a plain, light grey.

Fabrizio Sara
The MathWorks Italy
Managing Director

**It is expected, that by 2022,
27% of available jobs will be in
roles that don't yet exist.**

- Boston Consulting Group



Agenda

- A look to the future

Megatrends

- MathWorks

How do we respond to Megatrends

- Modeling and Simulation

Model Based Design, capture intellectual property

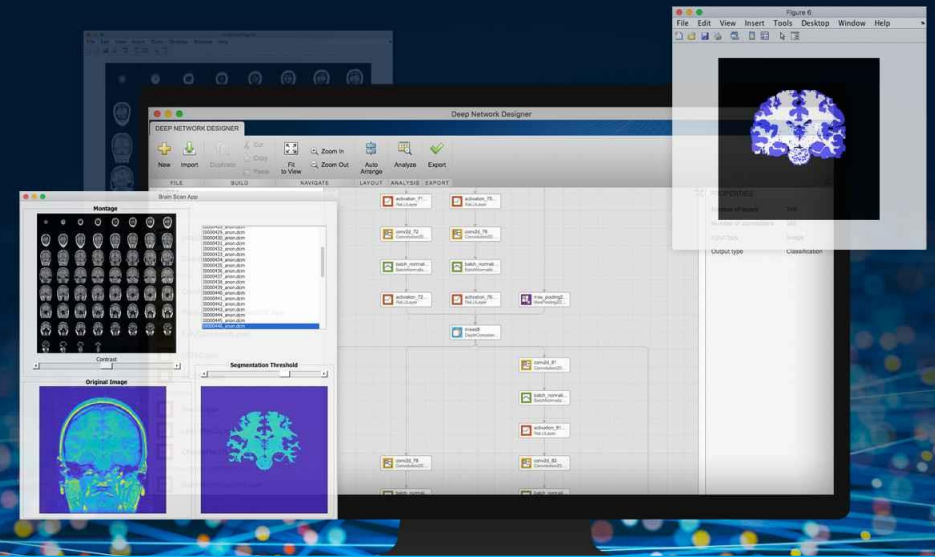
- The engineering Platform for AI

Artificial Intelligence in The MathWorks

- Opportunities

Where to invest to align with the emerging trends

MATLAB® & SIMULINK®



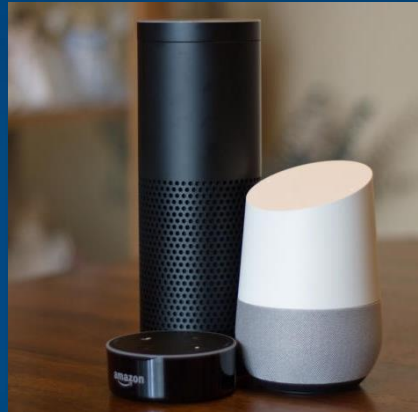
A look to the future



1

Algorithms and Software in Everything

- Smart devices
- New machines
- All university departments, not just computer science

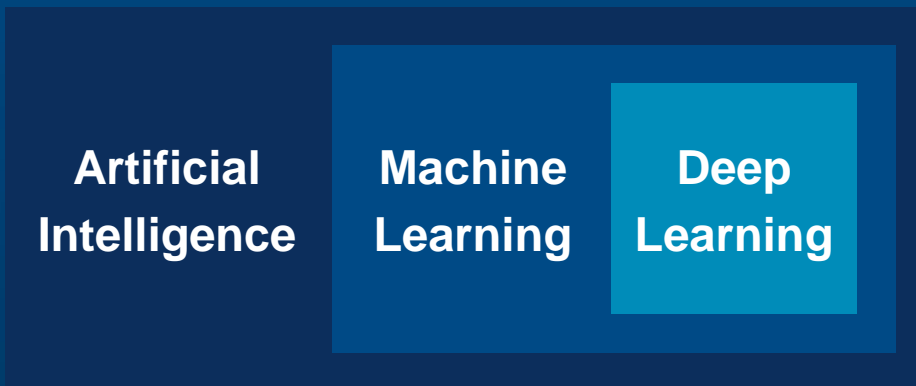


Transistor Production per Person



2 Artificial Intelligence (AI)

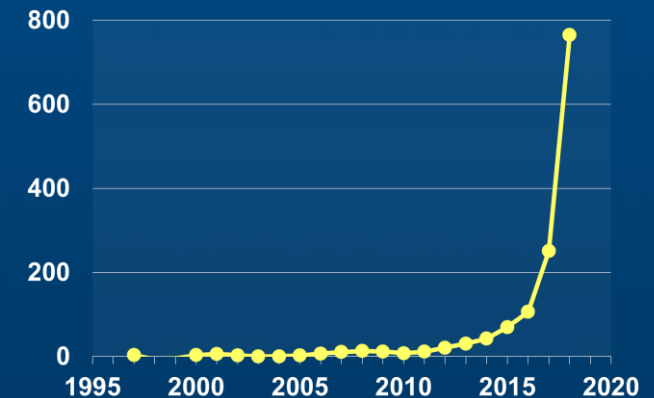
- Machine Learning
- Deep Learning



Machine Learning publications



Deep Learning publications



3

Autonomous Systems



Digital Transformation

Companies

- “Last-mile” connection to their customers
 - “Sensors”, telemetry, usage data
- Software in everything
- Data science
- AI (Machine and Deep Learning)
- Industry 4.0

5 Rise of Cloud Platforms

- Amazon Web Services, Microsoft Azure
- Containerization, orchestration
- Software processes migrating into engineering and science
 - Agile
 - Repos
 - Continuous integration



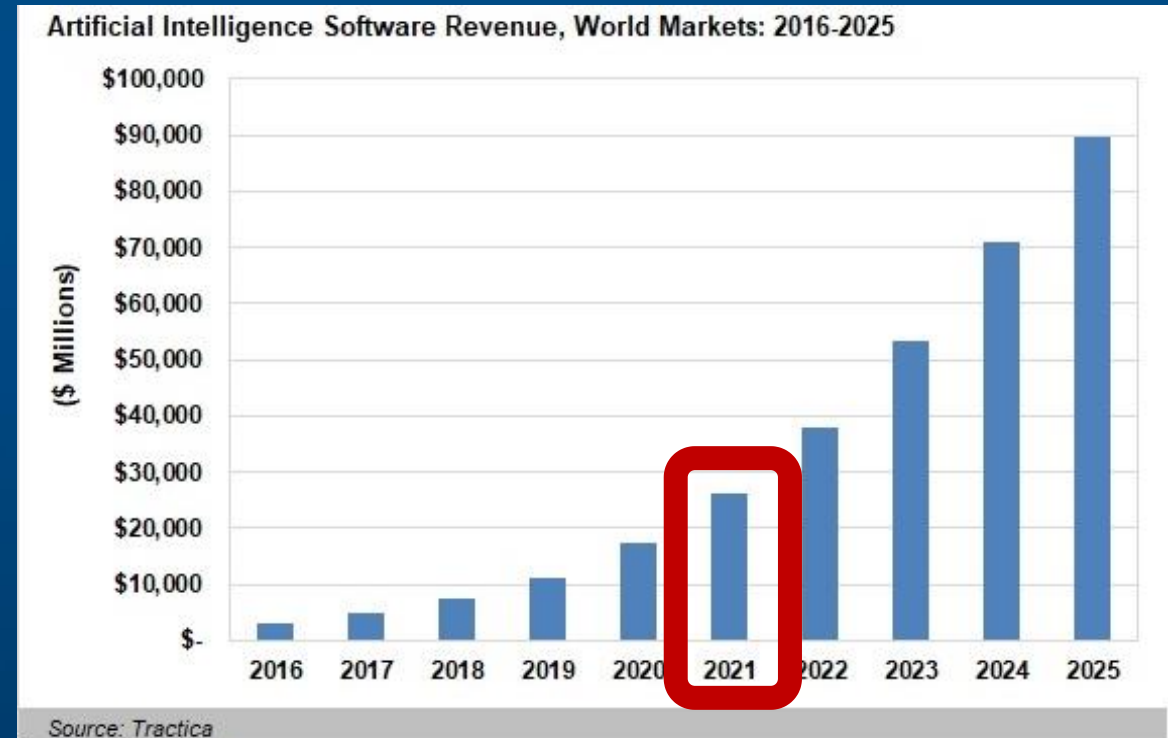
6 Electrification of Everything

- Transportation
- Shift from Internal Combustion Engine only to Electric and Hybrid-Electric Vehicles
- Building heating and cooling
- Small electric motors in everything

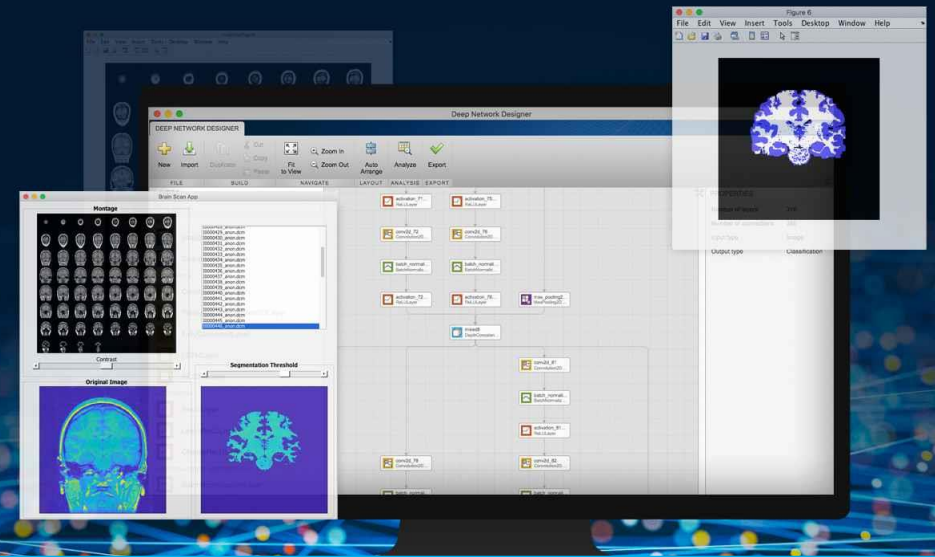


2021 MEGATRENDS

1. Software in Everything
2. Artificial Intelligence
3. Autonomous Systems
4. Digital Transformation
5. Rise of Cloud Platforms
6. Electrification of Everything



MATLAB® & SIMULINK®



The MathWorks



MathWorks Capabilities Adopted Across Industries



Aerospace and Defense



Automotive



Communications
"Use high science, engineering, and



Neuroscience



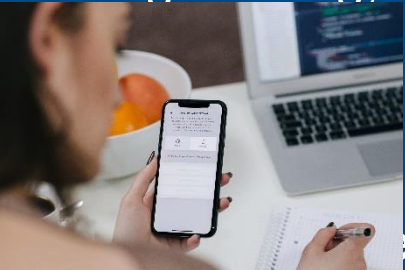
Biological Sciences



Railway Systems



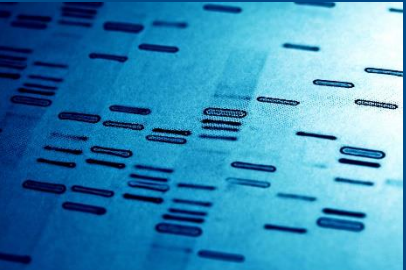
Energy Production



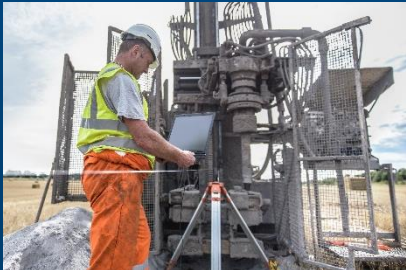
Electronics
Non legacy systems, increasingly data-
centric and



Medical Devices



Biotech and Pharmaceutical



Process Industries



Industrial Machinery



Semiconductors



Software and Internet



Financial Services

“Everyone who comes in as a new hire already knows MATLAB, because **they all had it in college**. The learning curve is significantly lessened as a result.”

Jeff Corn, Chief of Engineering Projects Section
U.S. Air Force



- MATLAB and Simulink are the tools of inspiration and innovation used by students, educators, and researchers around the world.



6500+

colleges and universities
teach our software



2100+

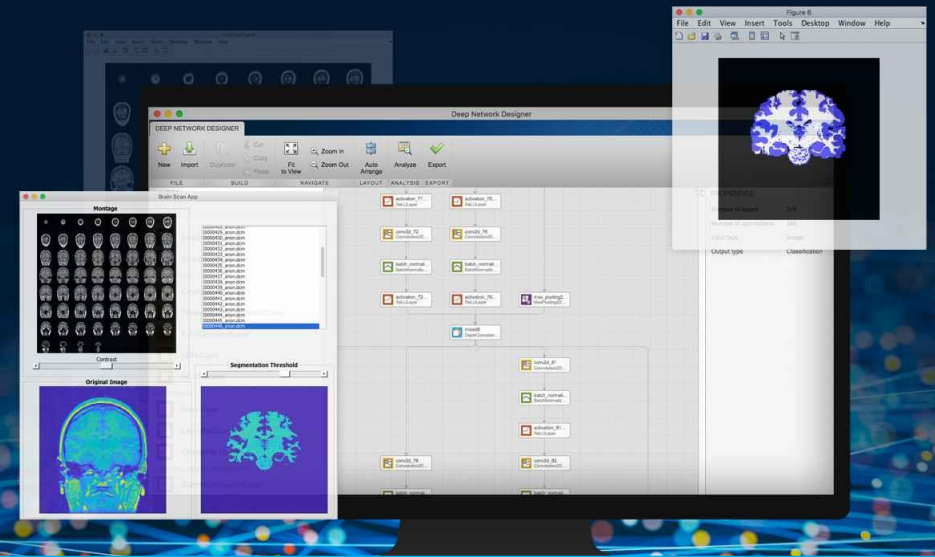
MATLAB and Simulink-
based books



Tens of Thousands

of skilled graduates enter
the workforce each year

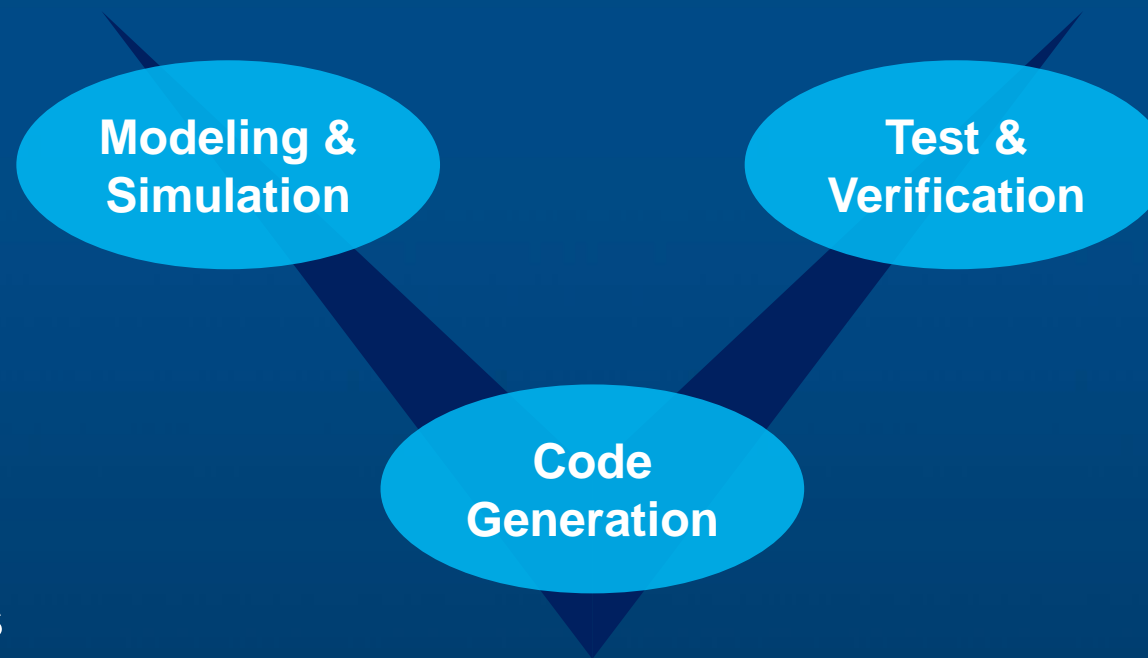
MATLAB® & SIMULINK®



Modeling and Simulation



Model-Based Design



Ease-of-use
Vertical solutions
Scaling up

Vertical solutions

MODELING & SIMULATION

Controls



Signal Processing



Wireless



Vision

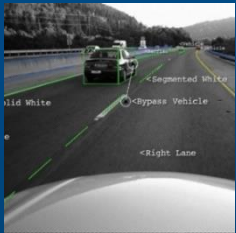


Robotics

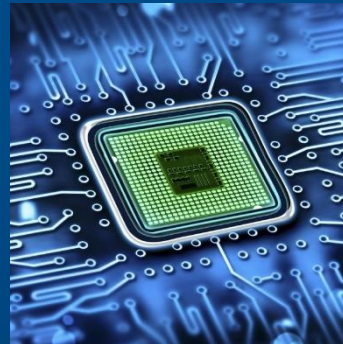


Vertical solutions

MODELING & SIMULATION



Chip Design



Mixed-Signals

Electric Motors



Motor Control

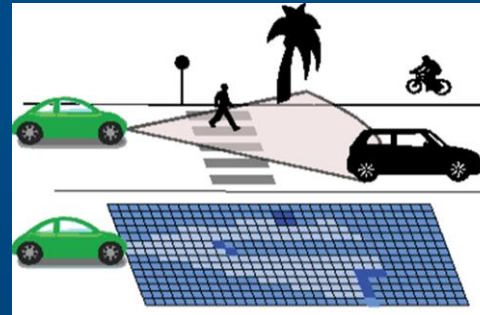
Vertical solutions

MODELING & SIMULATION



Autonomous systems

Navigation & Tracking



Sensor Fusion & Tracking
Navigation

Perception



Deep Learning
Computer Vision
Phased Array
LIDAR

Industry



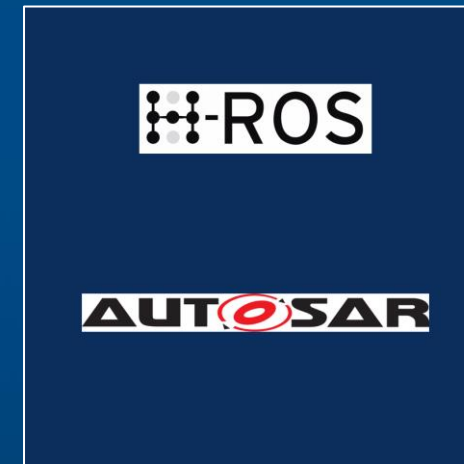
Automated Driving
Robotics System
UAV

Vertical solutions

MODELING & SIMULATION



Software Services



Vertical solutions

MODELING & SIMULATION

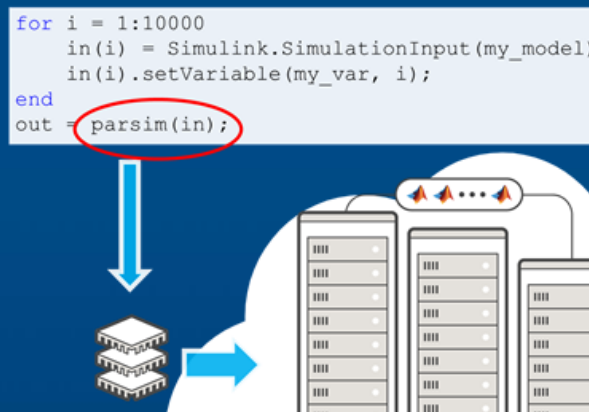


Scaling up

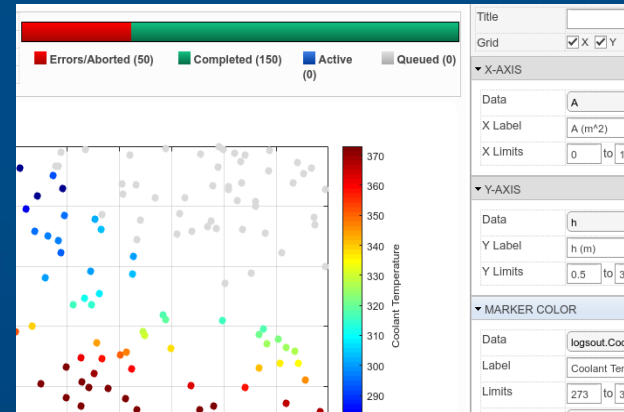
MODELING & SIMULATION



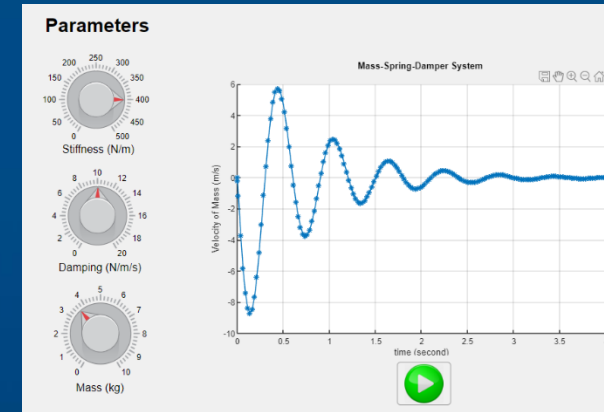
X 1,000,000's



Parallel simulations



Simulation Manager



Simulink Compiler



**Modeling &
Simulation**

**Code
Generation**



Code
Generation

```
#include "AutomatedParkingValeAlgorithm.h"
#include "AutomatedParkingValeAlgorithm_private.h"

int32_T div_s32_floor(int32_T numerator, int32_T denominator)
{
    int32_T quotient;
    uint32_T absNumerator;
    uint32_T absDenominator;
    uint32_T tempAbsQuotient;
    boolean_T quotientNeedsNegation;
    if (denominator == 0) {
        quotient = numerator >= 0 ? MAX_int32_T : MIN_int32_T;
    }
    // Divide by zero handler
    else {
        absNumerator = numerator < 0 ? ~static_cast<uint32_T>(numerator) + 1U :
            static_cast<uint32_T>(numerator);
        absDenominator = denominator < 0 ? ~static_cast<uint32_T>(denominator) + 1U :
            static_cast<uint32_T>(denominator);
        quotientNeedsNegation = (numerator < 0) != (denominator < 0);
        tempAbsQuotient = absNumerator / absDenominator;
        if (quotientNeedsNegation) {
            absNumerator %= absDenominator;
            if (absNumerator > 0U) {
                tempAbsQuotient++;
            }
        }

        quotient = quotientNeedsNegation ? -static_cast<int32_T>(tempAbsQuotient) :
            static_cast<int32_T>(tempAbsQuotient);
    }

    return quotient;
}

void AutomatedParkingValeModelClass::APV_emxInit_real_T(emxArray_real_T_T
**pEmxArray, int32_T numDimensions)
```



**Modeling &
Simulation**

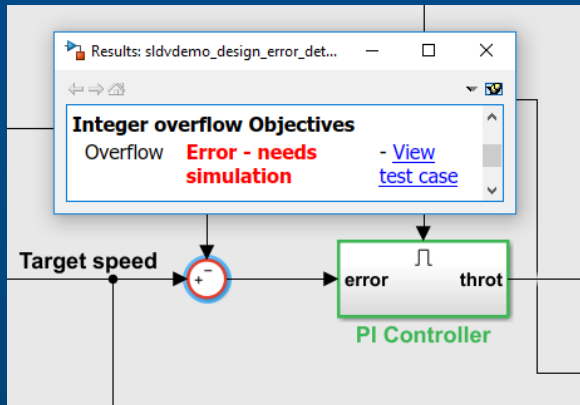
**Test &
Verification**

**Code
Generation**

Automated Test and Verification

TEST & VERIFICATION

Find bugs



Manage tests

Test Manager

TESTS

Filter tests by name or tags, e.g. tags: test

- sttestProjectorFanSpeedTestSuite
 - Fan Speed Parametric Study
 - Fan Speed = 800
 - Fan Speed = 1300
 - Fan Speed = 1800
 - Fan Speed = 2300

PROPERTY VALUE

PROPERTY	VALUE
Name	Fan Speed = 1300
Type	Baseline Test
Model	sttestProjectorFanSp...
Harness Name	FanSpeedTestHarness
Simulation Mode	[Model Settings]
Location	C:\Program Files\MA...
Enabled	<input checked="" type="checkbox"/>
Hierarchy	sttestProjectorFanSp...

Fan Speed = 1300

sttestProjectorFanSpeedTestSuite > Fan Speed Parametric Study > Fan Speed = 1300

Baseline Test

Select releases for simulation:

☐ Create Test Case from External File

TAGS

DESCRIPTION

REQUIREMENTS

SYSTEM UNDER TEST*

Model: sttestProjectorFanSpeedExample

TEST HARNESS*

Harness: FanSpeedTestHarness

Check & coverage



Inspect code

Code Verification Results : Verified

Function Interface Verification Results : Verified

Function	Status	Details
slcdemo_roll_initialize	Verified	-
slcdemo_roll_step	Verified	-

Model To Code Verification Results : Verified

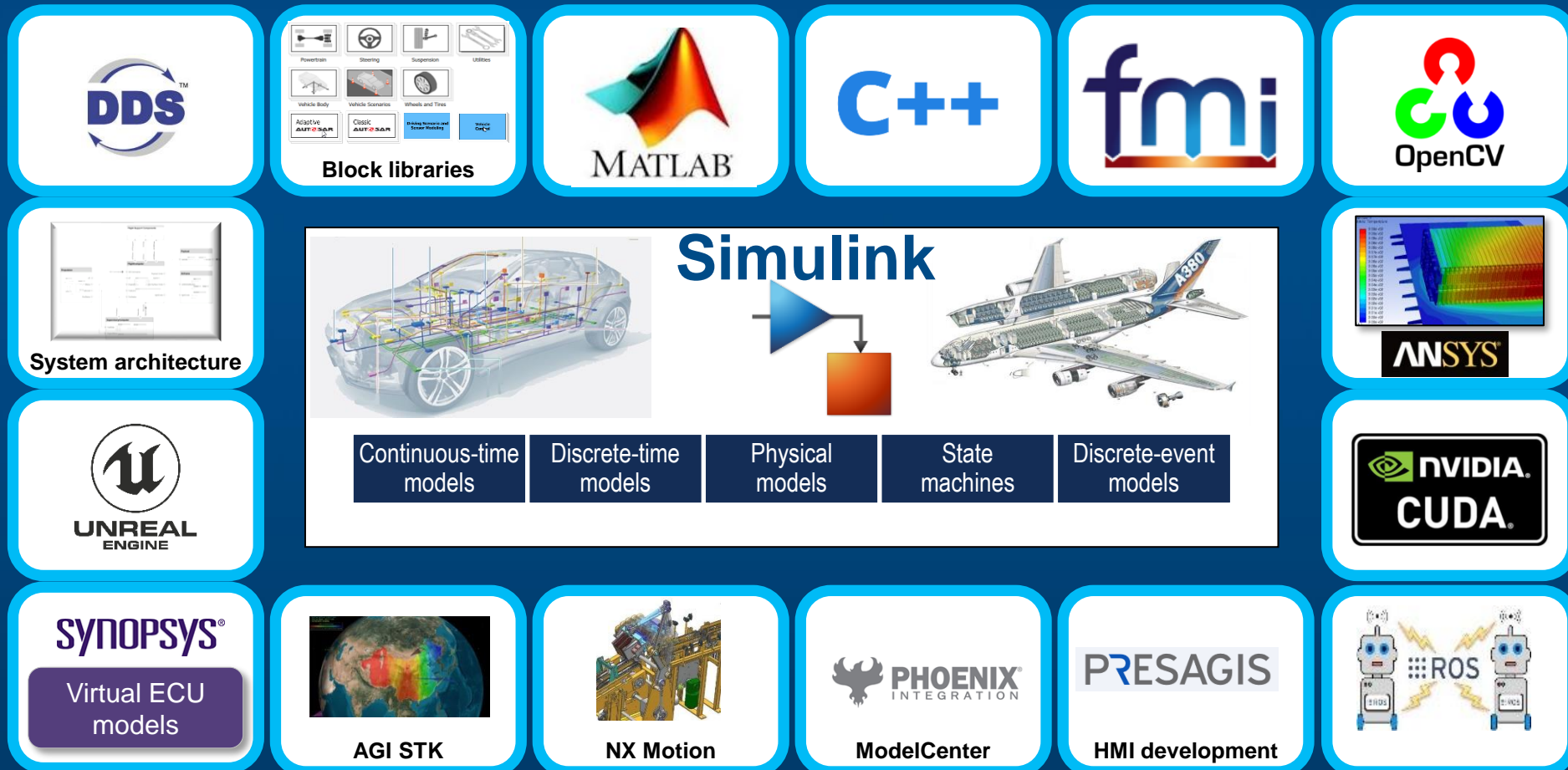
Status	Details
Verified	Model objects with status Verified : 42
	Model objects with status Partially processed : 0
	Model objects with status Unable to process : 0
	Model objects with status Failed to verify : 0

Simulink is the Simulation Integration Platform

Modeling & Simulation

MODELING & SIMULATION

Ecosystem with 100+ third-party tools and languages



Hardware is supported across workflow

CODE GENERATION

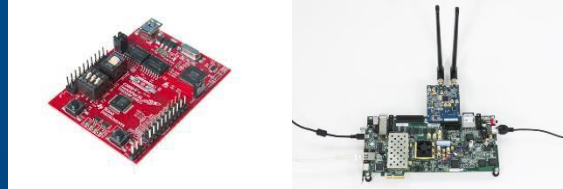
Mass-market low cost hardware

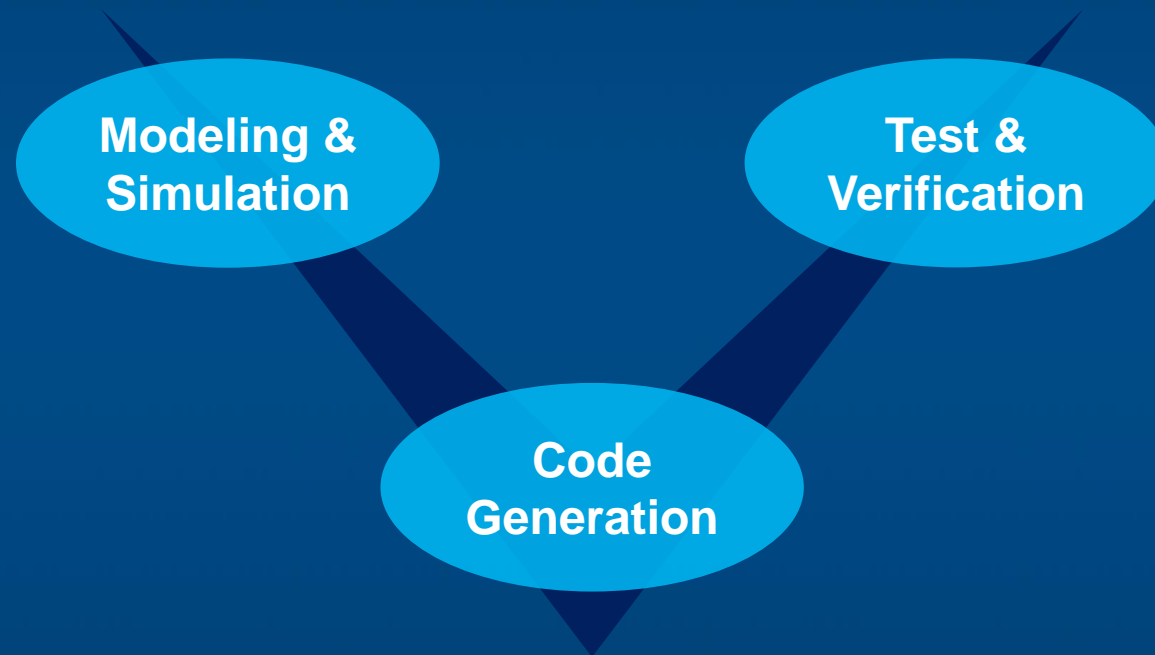


Rapid prototyping hardware

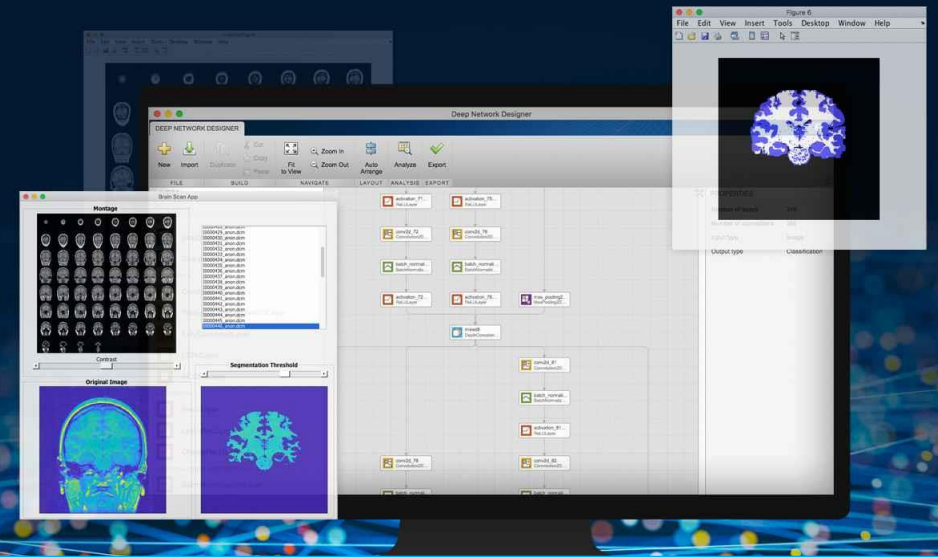


Commercial hardware





MATLAB® & SIMULINK®



The engineering platform for AI





1

Data
Preparation

2

AI
Modeling

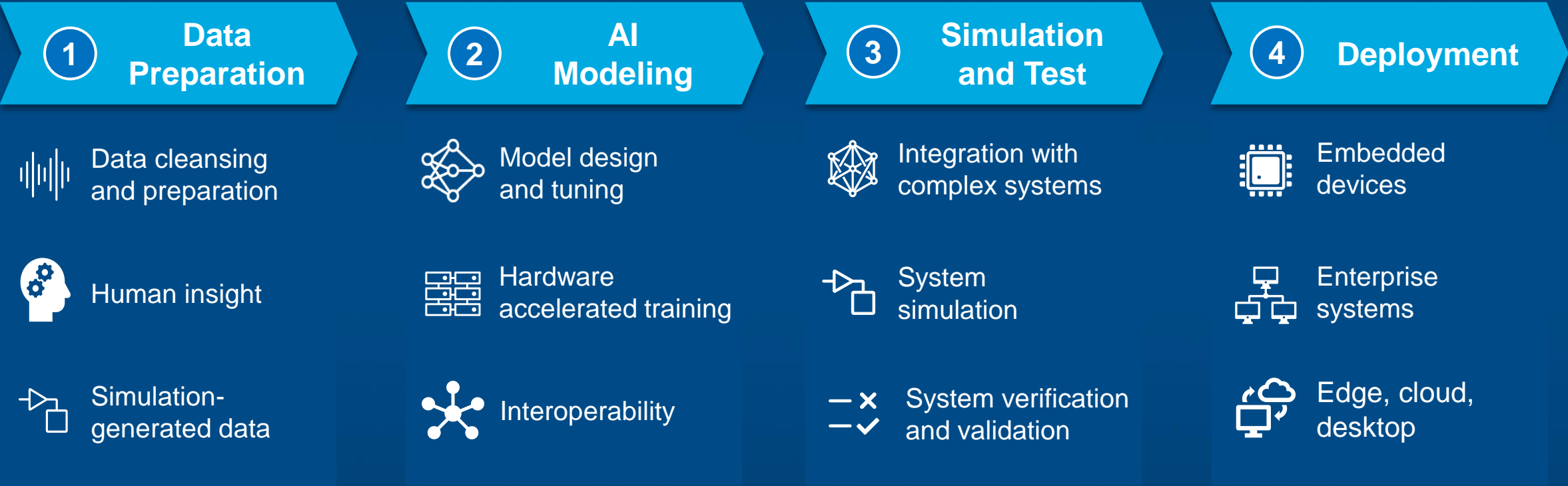
3

Simulation
and Test

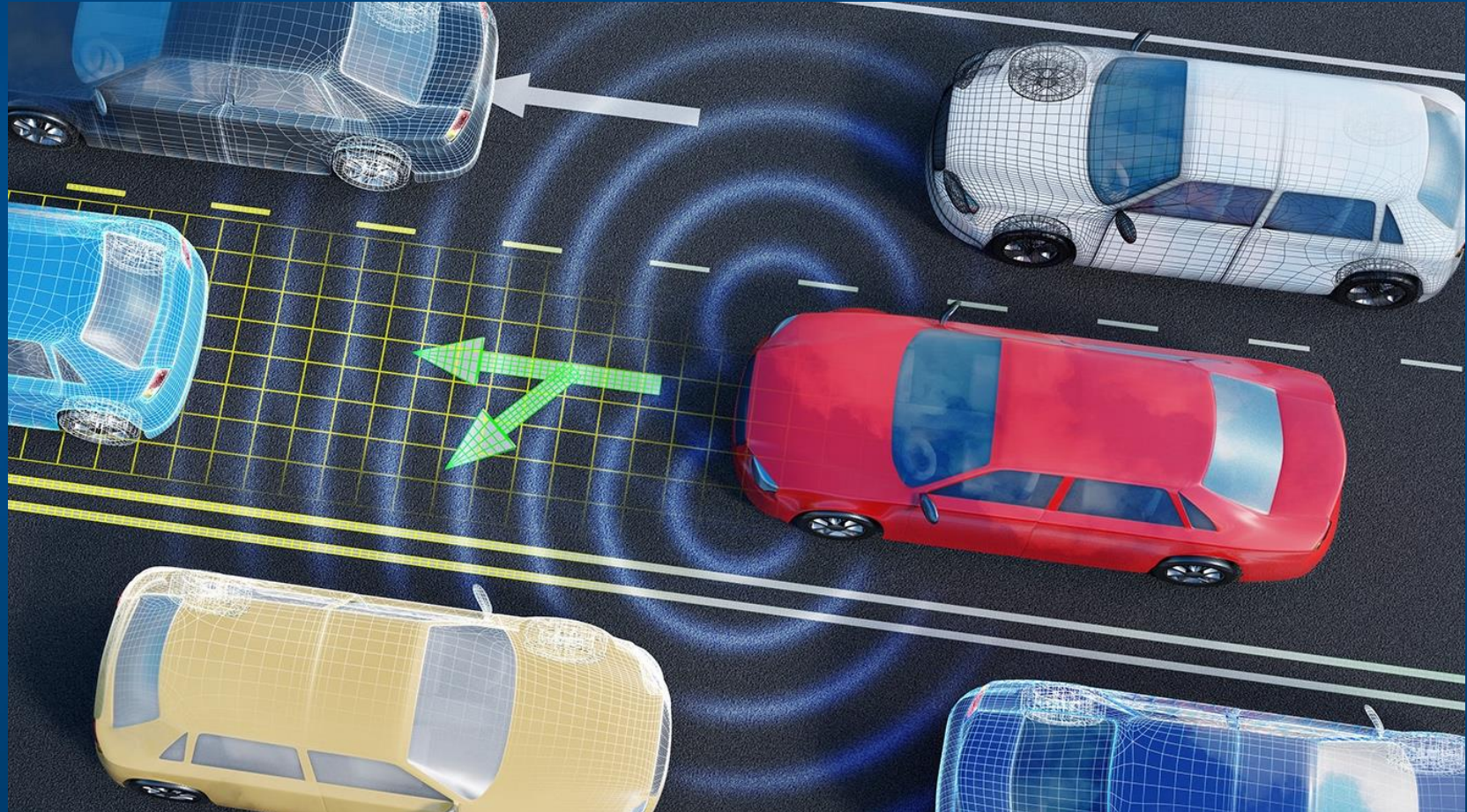
4

Deployment

AI-driven system design workflow



Integrate AI into system-wide context, simulate before moving to hardware, and verify effectiveness



① Data Preparation

② AI Modeling

③ Simulation and Test

④ Deployment

Simulate rare system failures to avoid them in the real world

1

Data
Preparation

2

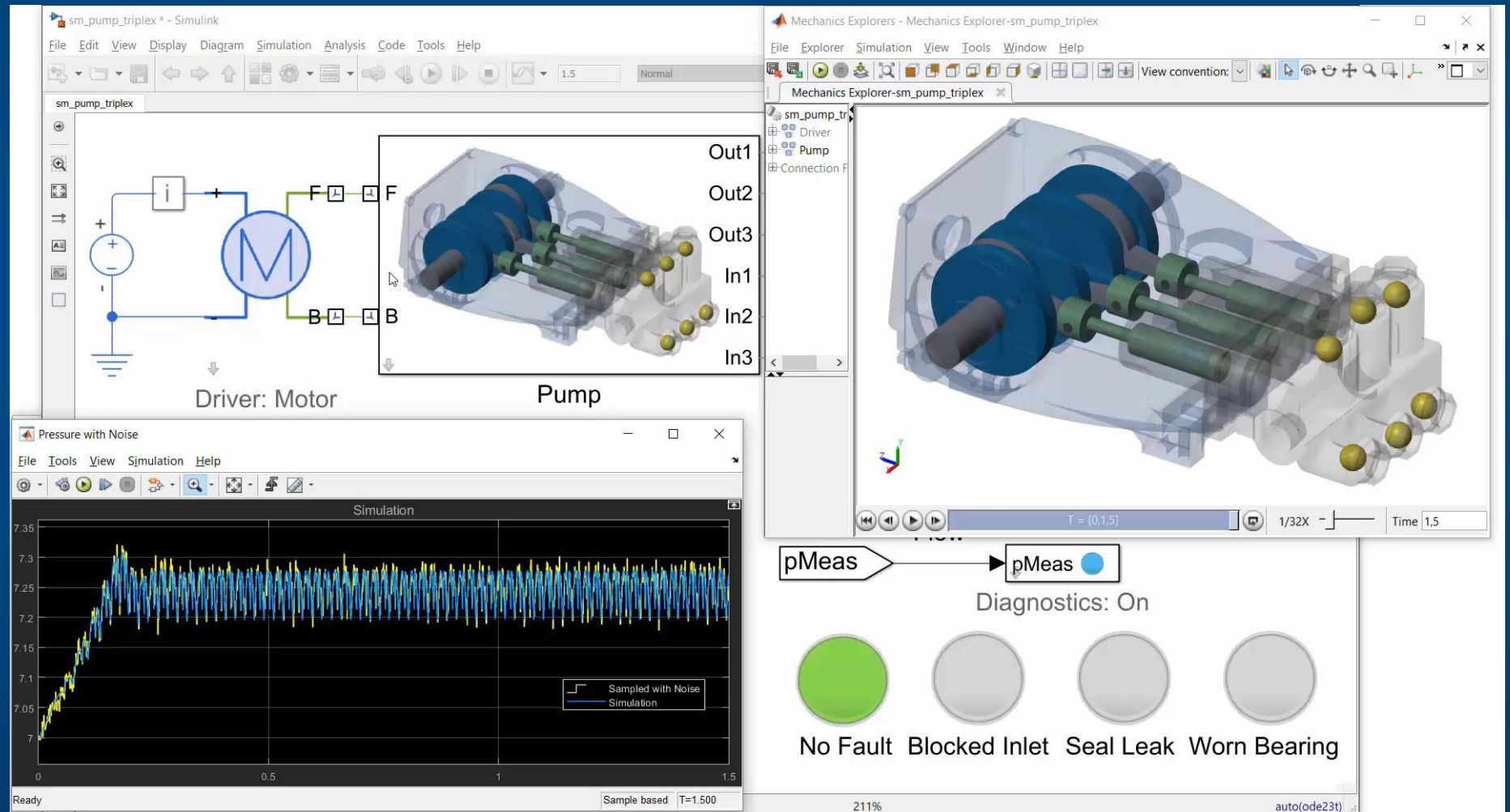
AI
Modeling

3

Simulation
and Test

4

Deployment



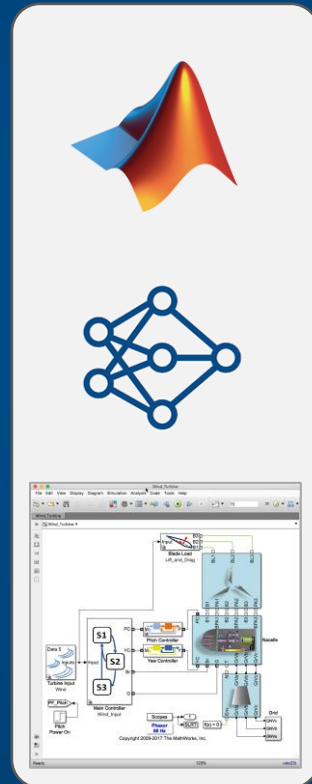
Deploy to any processor with zero coding errors

1 Data Preparation

2 AI Modeling

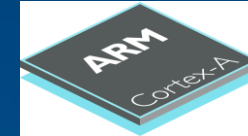
3 Simulation and Test

4 Deployment



Code Generation

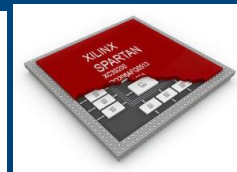
CPU



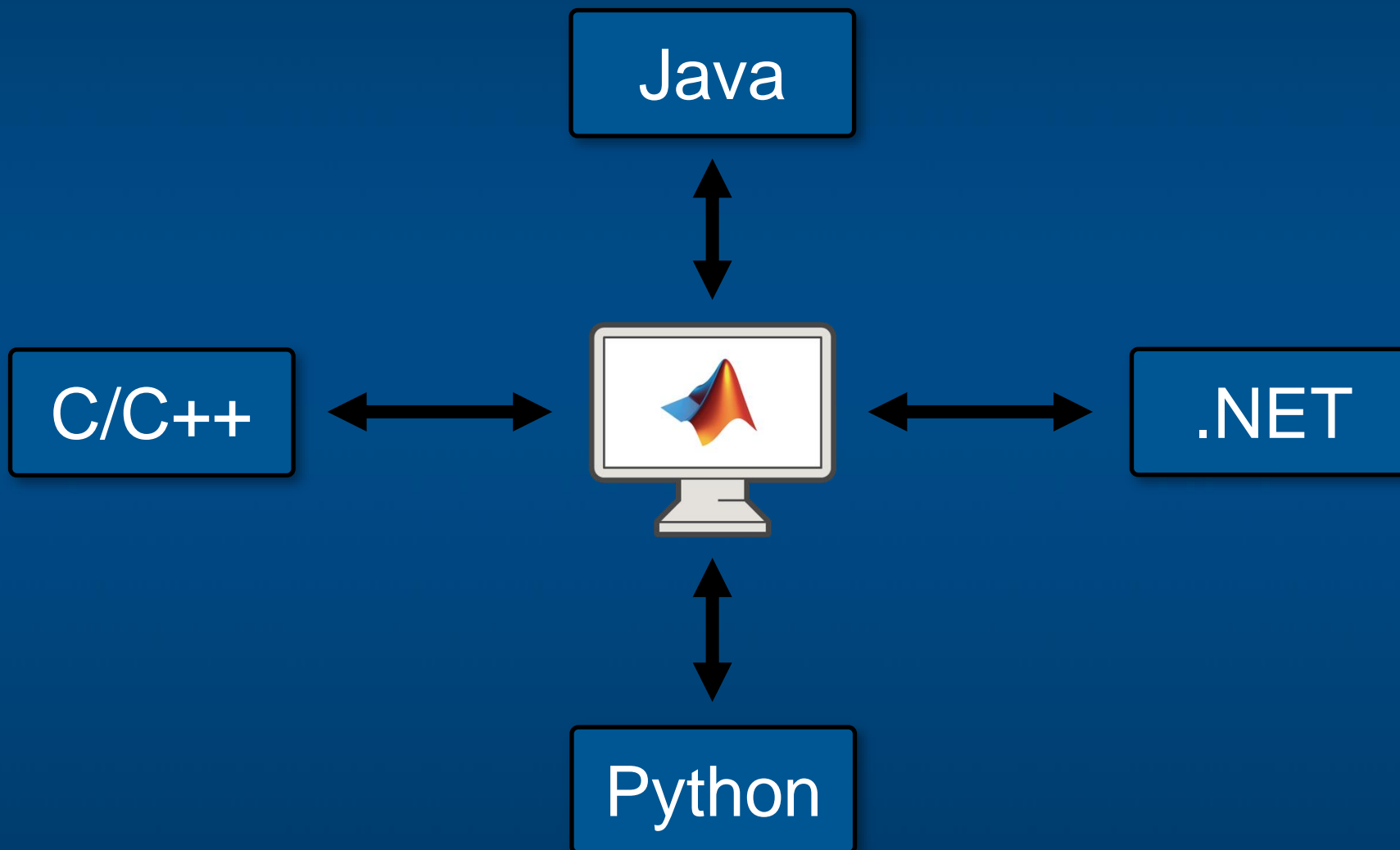
GPU



FPGA



MATLAB provides flexible integration with multiple languages



Data
Access

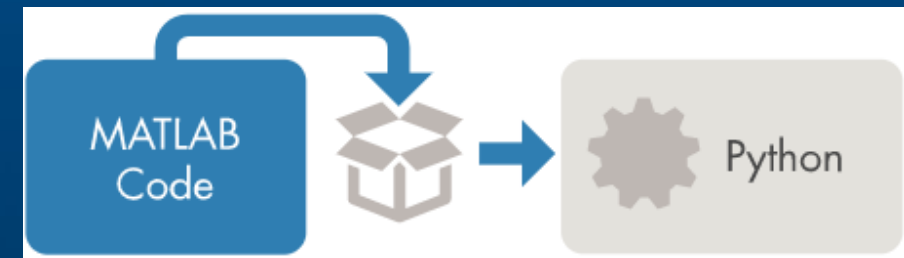
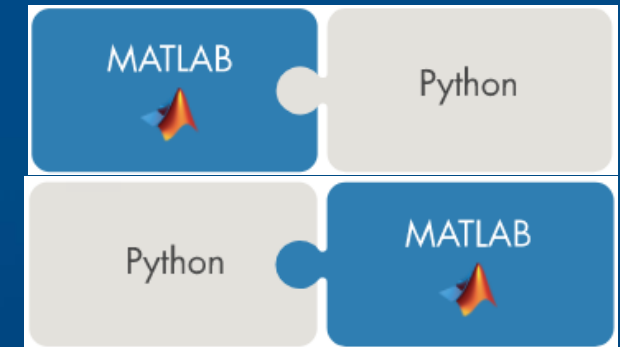
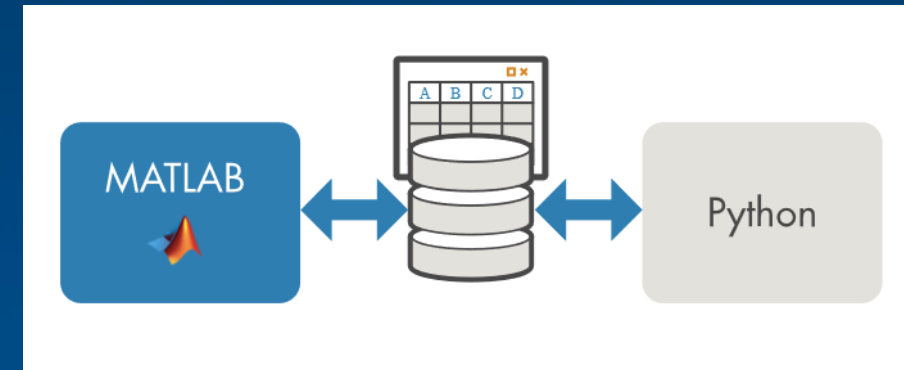
Co-Execution

- Call Python from MATLAB
- Call MATLAB from Python

Deployment

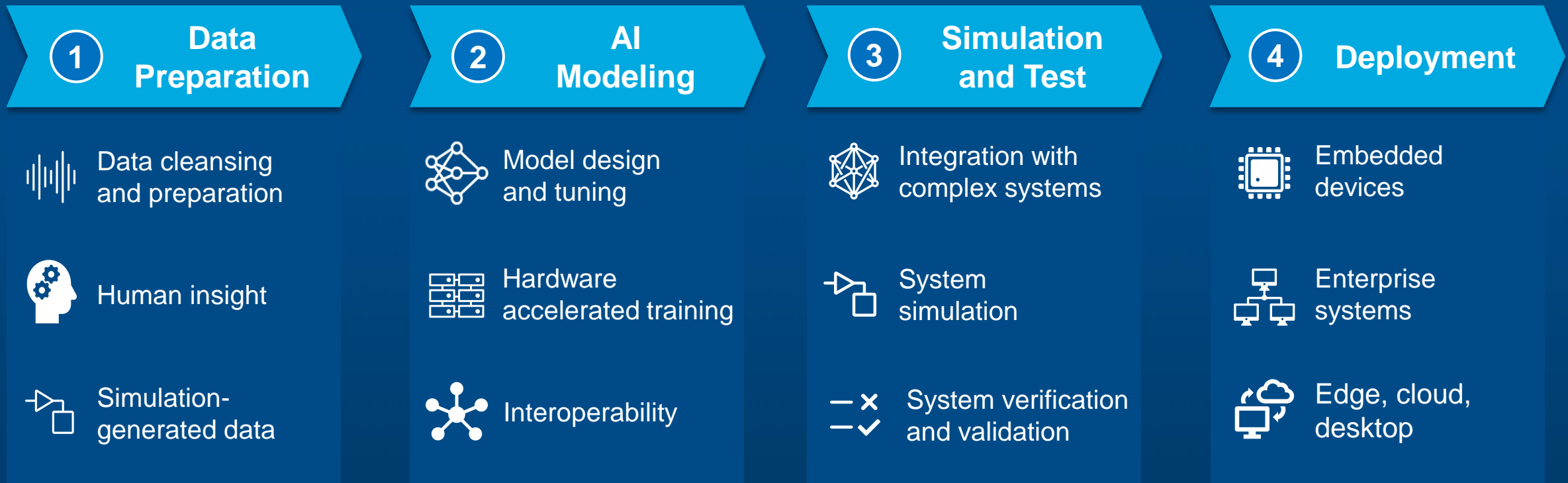
Summary: Using MATLAB with Python

- Access Data
- Interoperability
 - Calling libraries written in Python from MATLAB
 - Calling MATLAB from Python
- Deploy Apps & Algos
 - Web App
 - Production API

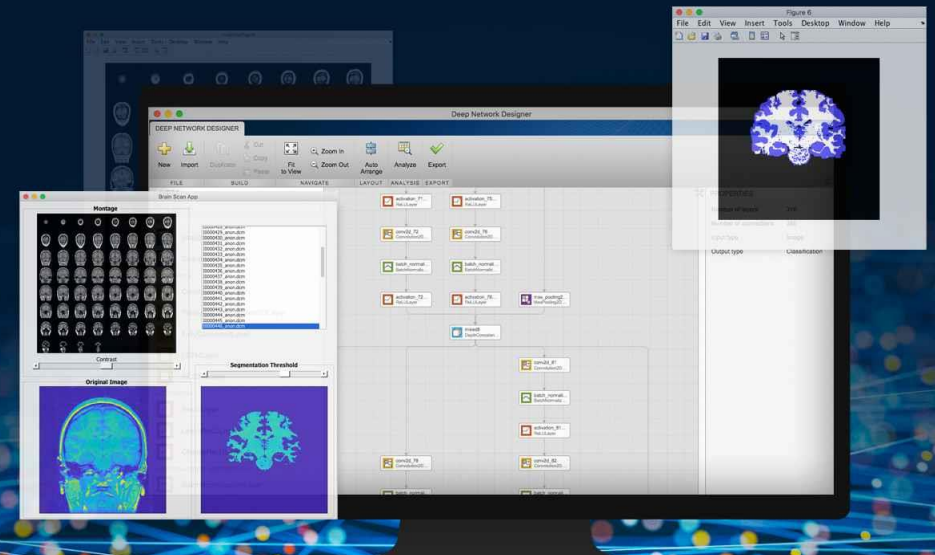


Why MATLAB and Simulink for Artificial Intelligence?

- Empower domain experts, including ones with limited AI experience
- Build better data sets with domain-specific tools
- Use modeling and simulation to tackle integration challenges and reduce risk
- Deploy AI models to wherever you need them



MATLAB® & SIMULINK®

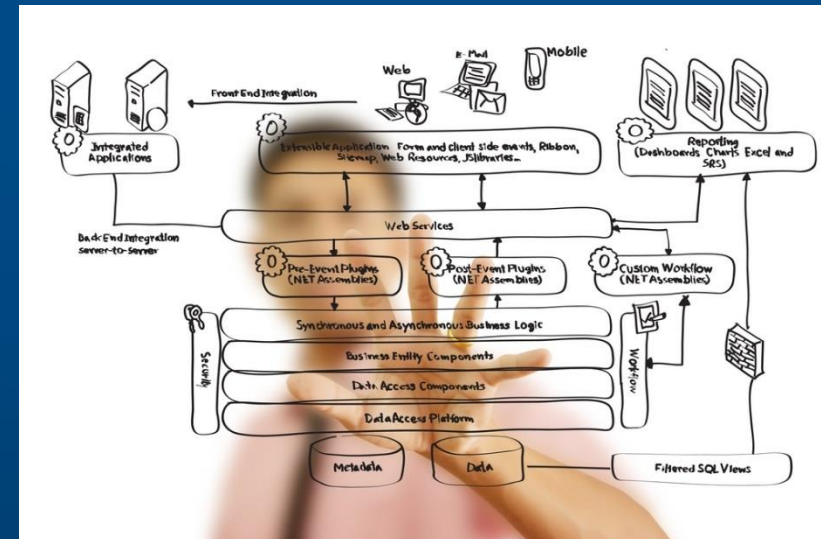


Opportunities



Software Quality Requirements

- Non-functional requirements (System Architecture) impose constraints on functional requirements (System Design)
- Specifying how a system is supposed to be or behave:
 - USABILITY
 - RELIABILITY
 - PORTABILITY
 - COMPATIBILITY
 - REUSABILITY
 - CONFIGURABILITY
 - AVAILABILITY
 - ...



Companies need people who know how to think...

University needs to provide companies with people who know how to think...

Business needs	Impacts
Ability to translate math models of dynamics into systems and behaviors	Core business potentially eroded
Accuracy and fidelity in models	Suboptimal performance, reduced market share
Performance in SW for tests and for deployments	No certifications: barrier to enter new markets
Systemic thinking, ability to optimize	Delays, less innovative, lost sectors
Objectives setting, Track projects, Quality concerns	Impacted communication, quality concerns
Verification & Validation	Compliancy with standards, lost markets
Standards compliancy	Potential barrier
Manage complexity properly and accurately	Lower quality products
...	...

Where should time be invested?

AI & System theory / thinking

- Dynamic models
- Manage complexity
- Requirements management

Data & Test management

- Optimize Performance
- Verification & Validation
- Quality concerns

Deployment

- Automatic code generation
- Standards & certifications

History suggests that companies that invest in innovation through a crisis outperform peers during the recovery.

Normalized market capitalization, index (Q1 2007 = 100)



*Identified as companies on the *Fast Company* World's 50 Most Innovative Companies list for ≥ 2 years through a crisis, normalized to 2007.

McKinsey
& Company



An open exchange for the MATLAB and Simulink user community

A place where you can get answers, challenge yourself and others, and share your knowledge.
Tap into the knowledge and experience of over 100,000 community members and MathWorks employees.

Ask and Answer

Get & Share Code

Read and Learn

Play

Explore IoT Data

CONTRIBUTORS

365,000

ANSWERS PER DAY

120

DOWNLOADS PER DAY

25,000

SOLVERS PER DAY

730

Project-Based Learning with Low-Cost Hardware

MATLAB and Simulink speak hardware

Treat engineering students like engineers with real projects

Easy-to-learn syntax and block diagrams

Increase student interest and improve learning

<https://www.mathworks.com/hardware-support/home.html>



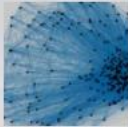
MATLAB for Academia

<https://www.mathworks.com/academia>

Impara le nozioni base

Inizia con lezioni ed esercizi interattivi per acquisire familiarità con MATLAB e Simulink. Tutorial MATLAB e Simulink

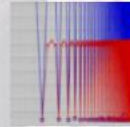
Esercitazioni MATLAB



Esempi di codice MATLAB

Risolvi problemi come il curve fitting, il plotting e l'elaborazione di immagini con esempi di codice.

» Per saperne di più

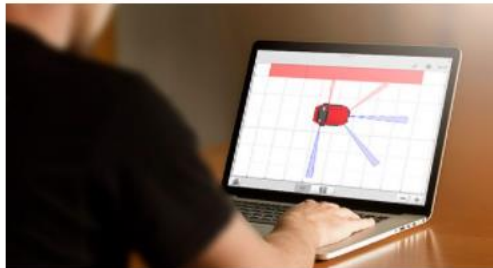


Esempi Simulink

Scopri la modellazione e la simulazione di diversi sistemi dinamici guidato da script e file di modello.

» Per saperne di più

Insegna e ispira



Insegnare con MATLAB e Simulink

Migliora il tuo corso di studi con strumenti didattici ed interattivi pronti all'uso

» Visualizza tutti i materiali didattici



Fare ricerca con MATLAB e Simulink

Esplora ed esprimi nuove idee, collabora con GitHub e crea codici e modelli robusti e riutilizzabili.



Crea e valuta automaticamente le attività

Utilizza MATLAB Grader per creare attività di programmazione MATLAB per gli studenti e valuta automaticamente il loro lavoro.



Corsi MATLAB

Scarica i contenuti dei corsi per sviluppare e migliorare il tuo curriculum.



Live Editor

Crea lezioni che combinino testo esplicativo, equazioni matematiche, codici e risultati.

Student Competitions prepare students for careers

Student Competitions

MathWorks sponsored [44 competitions](#) and provided software to [2800 teams](#) in 2017

Fields include automotive, aerospace, biotech, programming, and robotics



Self-Paced, Online Training for MATLAB & Simulink

The screenshot displays the MATLAB Deep Learning Onramp course interface. The browser address bar shows the URL: <https://matlabacademy.mathworks.com/R2018b/portal.html?course=deeplearning#chapter=2&lesson=1§ion=1>. The course title is "Deep Learning Onramp" with a progress indicator of "(0% complete)". The user's name, "Stephen Frail", is visible in the top right corner.

The main content area is titled "2.1 Course Example - Identify Objects in Some Images". It features a "Task 1" section with the instruction: "You can use the `imshow` function to display an image stored in a MATLAB variable". The task pane on the left shows the code `imshow(I)` and a "TASK" box with the instruction "Display the imported image in the variable `img1`". Below the task pane, there are links for "Hint", "See Solution", "Reset", "Submit", and "Next task". The "Test Results" section shows "Correct!" and a green checkmark indicating "Is `img1` displayed correctly?".

The central workspace area is titled "View image files" and contains instructions: "Instructions are in the task pane to the left. Complete and submit each task one at a time." Below this, there are three task sections:

- Task 1:** Import an image. The code editor shows `img1 = imread('file01.jpg')`.
- Task 2:** View image. The code editor shows `imshow(img1)`.
- Task 3:** Import and view more images. The code editor is currently empty.

On the right side of the workspace, there is a variable viewer showing the contents of `img1`: `img1 = 227x227x3 uint8 array`. Below this, there is a preview of the image loaded into `img1`, which is a landscape photo of a beach and trees.

Campus-Wide Online Training

Hands-on MATLAB and Simulink experience

Measurable progress report and completion certificate

Interactive lessons with immediate feedback

24/7 availability

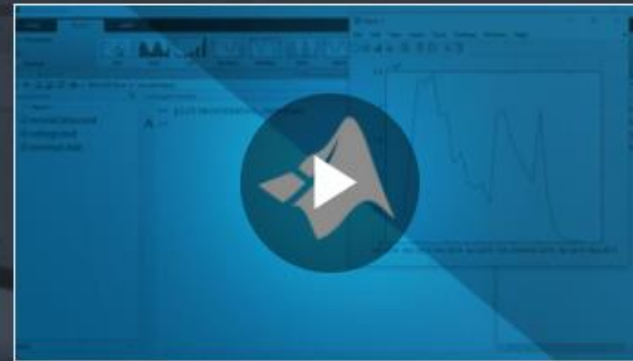
MATLAB Onramp

<https://www.mathworks.com/learn/tutorials/matlab-onramp.html>

MATLAB Onramp

Learn the essentials of MATLAB® through this free, two-hour introductory tutorial on commonly used features and workflows.

Launch the course



Access to MATLAB through your web browser



Engaging video tutorials



Hands-on exercises with automated assessments and feedback



Lessons available in English, Chinese, Spanish, Japanese, and Korean

Companies Compete for better Productivity

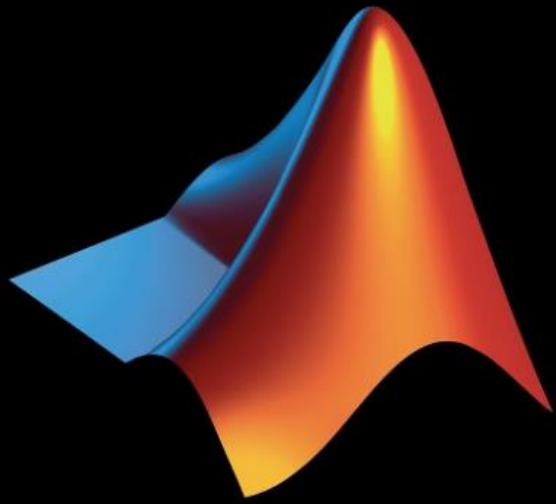
Quality is Productivity

Quality is driven by Competence

Summary

- Companies and Business require you to...
 - Develop and invest in algorithm & systems modeling and simulation skills
 - Learn to work in Teams
- MATLAB is in these markets already, since 1984
- MATLAB is the backbone of many engineering applications
- The MathWorks is making the right investments





MathWorks®

Accelerating the pace of engineering and science